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ABSTRACT

This paper demonstrates that the axis between cognition and multimedia language teaching is very short by introducing three fundamental concepts: (1) mediatizing, i.e., the direct use of any medium as a way of expressing oneself; (2) multimediatizing, i.e., the choice of a multimedia support to express a didactized informational content; and (3) re-multimediatizing, i.e., follow-up of learners' activity and appropriate modification of courseware. The LAVAC (Laboratoire Audio-Visuel Actif-Comparatif [Audio-Visual Active-Comparative Laboratory]) system, courseware developed in France, which includes a student interface and teacher software for distance and real-time tutoring in a computerized laboratory, is described. (Contains 11 references.) (MES)

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Cognition and Courseware Design by Teachers: the Concept of Multimediatizing

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Abstract: Cognition and multimedia language teaching seem to be at the two extremes of a very long axis. But the evolution of multimedia today makes it necessary to clearly define some seemingly transparent cognitive notions and functions that may otherwise deceive the teacher in his expectations. Furthermore, teachers are the only entitled persons to design courseware application after a very precise analysis of their own didactic needs. The question to be asked then is "*how?*", and the answer to that question may not be easy.
We shall try to demonstrate in this paper that this axis is in fact very short by introducing three fundamental concepts. The concept of Multimediatizing is one of them and enables satisfactory courseware design by non-programming teachers.

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Introduction

"I'm just a language teacher!", you would say to apologize for your rather short studies that make you able to read, speak and as a whole master a foreign language so that you can be entitled to teach it. Basically class teaching is not presenting a show, even if this presenter role should not be excluded at a particular point of the teaching schedule, e.g. at the end of a learning cycle for knowledge assessment or reinforcement purposes.

But language teaching and particularly second-language teaching is more than that and most teachers know it. In fact the amount of personal skills and knowledge competence necessary to achieve this so-called "simple" goal may somewhat be impressive.

The teacher must first be a linguist not only to be able to describe the surface of a particular language but preferably to explain the underlying mechanisms of language activity at a level common to both the mother tongue and the target one.

A second language teacher for science students for instance must then be sufficiently scientifically aware of the informational content carried by the language to be able to communicate with learners in their specific specialized fields. After a time, an L2 teacher in a science university in France must have an operational competence in scientific domains such as physics, astronomy, mathematics, electronics, computer science and technology since his or her students need to master these subjects in English for their future jobs.

If the word "language" in "language teaching" refers to linguistics and to the different specific purposes or specialty domains involved (literature and civilization are two of them), the second element is "teaching". Far from being an innate skill, even if taste, common sense and conviction should be put through it, teaching is a science. As a science, teaching starts from observation. The object to be studied is the teaching situation. Learners and the learning environment make up this situation.

This learner-centered approach should thus focus on the learner's needs. The individual needs will be identified and analyzed from the triple point of view of language knowledge, language use and specific purposes defined in each learner's syllabus (understanding science texts will not entail the same type of activities and learning tasks as trading on the phone for a company). After this analysis a specific teaching curriculum for this language can be set up.

Moreover the learning environment will set the place and time for learning.

Time is the key element. The contact with the language is ridiculously short if you consider the 20 to 30 hours a year a university student has in France. Didactic theories show that *how* to do things is then more important than *what* to do. Language acquisition cannot be intuitive in that instance as this could easily be possible with 10 hours a day in the country of the language.

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Place was traditionally the classroom. In a class of 30 to 70 students, the syllabus has to suit a hypothetical virtual student that would be the average of all of them and therefore would be appropriate to none of them. Moreover, the teacher is the only language provider. Oral language production on behalf of the students is then reduced to a few seconds per hour, when it takes place.

Technology changed these place and time constraints. Distance-learning is possible through the Internet and even in the language lab in the presence of the teacher, computerized learning induced a new didactic role on his or her part (i.e. a guide for individualized learning). He or she must learn this new role, he or she must know what multimedia can bring to the learners and thus multimedia technology has to be mastered. Collis (1996, p. 22) contends that the teacher has the responsibility for "the eventual success or lack of success of any computers-in-education initiative". Teachers should then be prepared to teach with technology, which is, after linguistics, specific fields and didactic theories, the fourth aspect of their training.

"Don't overdo it !", anybody would say to me at this point. Meanwhile a fifth competence is needed because multimedia technology makes it indispensable now. Individualized teaching calls for a multimodal interface that would suit the whole set of learning attitudes that cognitive sciences have clearly characterized for long.

Cognition is thus another field of competence for any teacher today that cannot be ignored. "Who still wants to be a language teacher ?" Positive answers will probably come from the ones who would take pleasure in seeing their students taking pleasure by working with their own customized software !

The concept of "Mediatizing"

The word "cognition" comes from the works of Plato and Aristotle. But cognitive sciences have only arisen since the 1950s (the MIT Symposia on Information Theory) and now are part of what philosophers call the unity of science: « perhaps as a consequence of the ever-increasing specialisation in science, scientists have found it important to work in an interdisciplinary manner where they can draw upon the research skills and knowledge bases of scientists trained in other disciplines » (Bechtel, 1998).

This necessary interdisciplinarity is more and more observed after the specialisation recommendations extolled at the beginning of the 70s. It now allow us to have a heuristic attitude towards any mental production. Before trying to imagine how to implement a didactized content according to different cognitive modes, it is essential to consider the status of this content. It is in fact something the teacher has in mind and something he or she has to express. At least a general idea of how things work from mind to expression may be useful.

Kathryn Bock has characterized this process in an interestingly synthetic way: « Psycholinguistic research on language production concerns itself with the cognitive processes that convert non verbal communicative intentions into verbal actions. These processes must translate perceptions or thoughts into sounds, using the patterns and elements of a code that constitutes the grammar of a language. For theories of language production, the goal is to explain how the mind uses this code when converting messages into spontaneous speech in ongoing time » (Bock, 1995).

A lot of research is being done in that field now (Pottier, 1992) and a theory is needed to formalize in a hierarchized and dynamic way the construction of representations drawn from experience and the personal calculations completed on these representations. Artificial intelligence or language translators[1] would need such a theory and cannot go on using words instead of concepts. A concept cannot be represented by a word, necessarily a discrete element in a particular language. Concepts belong to mind and have no linguistic colour. They may be represented by codes (Toma, 1984, p. 279) and these codes should then be organised according to different categories.

It is not possible here to develop this theory, still under construction. The theory has nevertheless nothing to do with chronogenesis and does not try to reproduce what happens in the human mind. Medical researchers may one day find it out, but as far as cognitive scientists are concerned, the construction of what

[1] PC Expert (November 1999, p. 168-174) has tested four leading translator systems: Reverso (www.softissimo.com), Systran (www.systransoft.com), Transcend 2.0 (www.transparent.com) and Power Translator (www.lhsl.com). None of them could properly translate in French the sentence " And God said, 'Let there be light,' and there was light". The correct translation is: "Et Dieu dit, 'Que la lumière soit,' et la lumière fût".
The obtained translations were respectively: "Et le Dieu a dit, 'Laisser là être léger,' et il y avait léger", "Et Dieu dits, 'laisser là léger,' et il y avait lumière", "Et Dieu ont dit, 'laisser il y a léger,' et il y avait léger" and 'Et Dieu ont dit, il y ait lumière, et il y avait léger" ! None of these translations make sense. The imperative form has never been translated properly and a general mistake has been made on the interpretation of light as an adjective ("léger") instead of a noun ("lumière").

happens in this "black box" has just to be imagined and tested through experiments. A brief outline of this construct can reveal a possible structure starting from a small number of metaconcepts, or "meaning atoms", that assemble in concepts (or molecules) according to the type and strength of the relations between them, then in groups of molecules (basic ideas) and in conceptual networks (sets of ideas) according to the different calculations occurring on these elements under specific conditions or goals[2].

According to Sperber, « mental representations are themselves objects in the world, and therefore potential objects of second-order representations or metarepresentations » (Sperber, 1999). So the task involved is in fact an artificial objectivation of subjectivity.

Even if metacognition is not a new science (James, 1890), the important point here is to clearly identify the frontier between the 'black box' (what is in mind, what is processed in mind, what is on the point of being expressed under a certain form or medium, still in mind), and what is expressed under a particularly chosen medium.

This medium can be *sound* for oral language and music, *image* for still pictures, films, painting and even writing, *movement* for dance, mimics and body expression, or *several media* linked together for a multimedia support (talking movies, television or multimedia computer).

This passage, this act of expression is what I call "*mediatizing*" ("Mise en média" in French). Mediatizing for me is a *semiotic* inscription. This term will NOT refer to the classical way of translating some different media (images, texts, sounds) already edited in a discrete way into a multimedia form ("Médiatisation" in French). On the contrary, it consists in the **direct** use of any medium, that is of any way of expressing oneself.

The concept of "Multimediatizing"

When a multimedia support is chosen to express a didactized informational content, the act of expression can therefore be called "*multimediatizing*". Multimediatizing is just a specific form of mediatizing even if it encompasses three different media: oral wording when a language is used under the form of sounds, written wording when a language is used under the form of letters and still or moving images to serve as a prop to the discourse situation.

Compared to television, computerized multimedia offers hypernavigation (direct access to any part of the informational content), interactivity (reaction to any action to assess the learner's tasks or to help him or her in case of errors) and multimodality that I would define as the possibility for the receiver to adapt the reception of each medium to his own cognitive mode (Toma, 1998)[3].

All these possibilities have to be exploited for an enlarged, deeper and richer learning process. But when you think "multimedia" to express yourself under a multimedia form, the problem is "Where to start ?". As far as language teaching is concerned, and particularly when English has to be taught to French students, the answer is undoubtedly from the SOUND and not from the text.

French students learning English usually have a fair level in understanding written English but would be at a semi-beginner level to understand spoken English. The reason is simple. Students have memorized the written form of words because it resembles the French written form. The pronunciation of the words, i.e. their oral form, which needs an effort to be remembered because the phonological system of English is completely different from the French, is either ignored or wrongly learned. Phonetics, the only way to write sounds on paper such as a score allows it for music, should be taught in high schools but is not, since most students do not even know what phonetics is about after 10 years of English! The University is there to make up for this lack of initial knowledge hoping that late is better than never.

Aural comprehension is therefore an urgent need for most students since they have a minimum of two years of English left (an equivalent of 20 to 40 hours!) before quitting the University.

Easy access to the sound should then be facilitated.

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[2] This branch of metacognition that I might call the « **cognitivo-discursive** approach » should even help us solve linguistic problems such as why in the two semantically close sentences « He went out in spite of the cold » and « the cold did not keep him from going out », the constraint laid on the concept of « going out » by the concept of « cold » is expressed in one sentence by the prepositional phrase « in spite of » and in the other one by the verb « keep from ».

[3] The learner should be able for instance to change the size of a picture (larger if he or she is of the visual type, smaller for the auditive types), or move it from the right to the left if this suits him/her better, but these possibilities must have been anticipated by the designer.

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At the beginning of the 90s when sound cards began to be installed in most computers, I imagined a new system enabling an automatic segmenting of the sound track according to the blanks or the volume drops in the sound signal detected by the system. The background noise can be parametered allowing a distinction between what is language sound and what is not, which makes segmenting possible even in case of a background music. The value of the blanks to be detected can also be parametered (from 0.2 second to 8 seconds). A "hard" segmenting rate of the sound track at a value of 0.2 second will give a large number of short sound segments (one word or more) to suit weak levels of students whereas a medium rate of 0.5 second will give a smaller number of longer sound segments for average-level students. Values above 1 second are simply used to segment a sound track in large paragraphs.

I called the system "*LAVAC®*" for "Laboratoire Audio-Visuel Actif-Comparatif " (Audio-Visual Active-Comparative Laboratory). This system which was first an authoring system gave birth to a student interface and a teacher software for distance and real-time tutoring in a computerized laboratory. The LAVAC system has been used in more than 150 universities in France and abroad since 1992.

Moreover during the automatic segmentation process, the system also creates an answering time span after each segment proportional to the length of each created segment. The proportional value can also be parametered in a 10 to 999 % range. I usually use a 150 % value, which means for instance that there is a 3-second answering time after a created sound segment of 2 seconds. This answering time can either be used as an automatic pause in aural comprehension for a better understanding process (because slower) or for note taking. But it can also be used for repetition of each segment, which is not as easy as one might think, since comprehension, memorisation and language production are involved in limited time.

Nevertheless few courseware programs take into account the notion of a **time-limit** for an answer. *« Only recently has temporal perception become a central issue again, because cognitive processes cannot be understood without their temporal dynamics »* (Pöppel, 1997). But this notion is fundamental to prepare the learner to react quickly in a virtual environment in order to make him/her ready for action in a real one

The sound track can of course be listened to without answering time and up to 24 ways of accessing the sound are possible in a LAVAC lesson with just a simple real-time segmenting of the sound track. The visualisation of the sound spectrum can be proposed for a better perception of the sound. But most importantly the sound segments are automatically numbered and visualised. Even if a segment selection is played in a listening or recording mode, any of them can instantly be accessed by a right click of the mouse. Any type of segment selection (continuous or discontinuous) is also possible.

These 24 ways of accessing the sound will obviously suit the different cognitive types of learners. Not surprisingly, the analytic type will listen to the sound track segment by segment, the synthetic will prefer a global listening of segments and the kinesic will listen to groups of segments. It is important to note that these different ways of accessing the track are generally independent from the learner's level or the difficulties of the material to be listened to.

In the LAVAC system, each numbered sound segment is in fact a sequence that can be given a name and that can be linked to a text (and/or a text answer), one or several images, a video and all types of exercises. In case of an error, an hypermedia link to one or several sequences of another lesson for revising or reinforcement can be set up by a mouse click.

Since all these possibilities can easily be implemented by a non-programming teacher, it is essential at that point to have minimum of knowledge of what cognitive science and particularly activity theories can bring us in the understanding of a learning process: the subject becomes the product of his or her own interactions in a conscious learning process.

Leontiev in 1972 posed three hierarchized levels of relations between the learning subject and the goals to be attained. The first is the intentional phase that defines the need to be satisfied (improved knowledge for example), the second, the strategies to be implemented and the third, the specific routines or acts that will involve and put into use pre-existing knowledge procedures.

Bruner in 1990 adds a recursive cycle at each step of this structure for assessment of the results obtained. The analysis of the discrepancy between the expected and the observed effects is the « fuel » of the dynamics of the system (feedback and auto-correction processes) until final satisfaction or failure.

The key phrase in language learning in a virtual environment is probably "learner's control for an accepted effort". The learner will better mobilize and stimulate his or her mental and cognitive abilities if he or she has a personal challenge to win. But he or she must be sure to win it with the necessary tools provided by the teacher.

Thus allowing an easily accessible solution with no time-limit to answer is certainly not the right solution to improve learning through multimedia teaching.

Videos that can be played with a "tickable" transcript option should then be avoided since aural comprehension is then transformed into understanding of oralised written English. At least this possibility of help for weak learners should come after a certain number of errors in the exercise section.

In the same way some (rare?) method designers should have a better epistemological insight of what they propose to their learners. Questions asked after a video played without any help of any sort cannot be answered if the sound has not been understood. But when multiple-choice questions are proposed, the learner can have the average if he is lucky! Is this still language learning ? What is the point of knowing that an answer is wrong without being able to understand why? If on the other hand the sound has been properly understood, questions should be better raised in a non-virtual environment with the teacher and the student alone or in small groups to check memorisation and favour oral expression and reuse of learned vocabulary.

In fact a machine must be used for what it can do best: tireless playing of the sound track with always the same quality, segmentation of this track, recordings, listening of recordings, visualization of segments, visualization of the sound track, comparisons of spectrograms, insertion of indexes in the segments for shorter ones if needed, recap functions for immediate listening from any index, role play, etc.

This is why I designed two new tools derived from LAVAC to help non computer-literate teachers create their own specific software in real time: the Audio Sequencer (Virtual recorder®) in 1998, and the Video [4]. These tools may also be used by teachers who consider that computer exercises are long to implement and can be given to the student in a "normal" session in a traditional classroom. In some cases access to the language lab is limited because of the large number of groups who want to use it, and again it is wise to choose to do with a machine what is impossible to do in the classroom.

But these tools could nevertheless be linked to the LAVAC student interface to give them what the machine alone cannot process: different levels of help. Help, missing in most software applications, are what will enable the student to find the solution by him or herself when they are presented in a graded way. There is no need of a Bayesian approach to distinguish between imposed hints, necessary for all the students and proposed ones only for those who need them or to assess the number and types of hints to be implemented.

Different values of the automatic segmenting enabled the same document to be used for different levels of students. Here again different levels of help in succession will make any document appropriate to a wide range of students, as long as there are no beginners or semi-beginners.

The aim in this approach is to base the software application more on the implementation of metalinguistic activities than on a classical acquisition of lexical or syntactic data.

The problem to be solved (with the problem of time) is then to implement the metalinguistic learning activities that will suit the different cognitive types, knowing that each learner more or less belongs to most or all of these types. Three sets of metalinguistic activities shall be introduced and most of these are based on the hypothetico-deductive techniques the learner commonly uses in everyday-life deductive reasoning.

- for sound discrimination and word recognition: a hierarchized list of different deduction help starting from wave spectrograms, phonetic transcription, lexical hints, written form of words
- for word and sentence meaning: etymology, knowledge of the discourse situation (solve a linguistic problem using an extralinguistic element of knowledge), contextual logic (the sentence is considered as in a crossword game where missing words are missing letters, and the context gives the clues) will be put into use to enable the learner to find the meaning of the words or the group of words by him or herself
- role of the image medium in understanding: an image can seldom be used to illustrate one particular word. It is only a prop for the understanding of the current language situation, especially if it is authentic. The learner will not have to wonder about the place, the look of the characters, even their self-expression, and all sorts of elements that might perturb him or her in his/her understanding process (Toma, 1996).

The concept of "Re-multimediatizing"

Even if different level segmenting of the sound track has been completed and a whole set of gap-filling or matching exercises and multiple-choice questions with hypermedia links in case of error has been devised, the work of the authoring teacher is not over.

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[4] See Toma, T. (2000). *Real-time course design: the LAVAC Video Sequencer*. SITE 2000, San Diego, Ca.
The video sequencer allows automatic real-time segmenting of sound AND images, with an automatic insertion of an answering time span after each segment.

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Even though or a range of possible help has been implemented with a semiological code coherent throughout the courseware, the authoring teacher should better go into the language laboratory to see what happens.

Cognitive types (analytic, synthetic, kinesic) are one thing, personality types are another. It is necessary to be in the language lab to observe different learning attitudes, most of them based more on work evaluation than on knowledge acquisition. The cautious or unadvanturous type will refrain from imagining any type of solution. The hints may be modified to make things easy and avoid any logical risk. The confident type on the contrary might not see the traps. Question marks, specific color codes should draw his or her attention to make him avoid simple mistakes. Others may be of a passive type. They want the solution immediately. Special tutoring is then needed, which is possible when a communication area has been designed in the language lab.

CD-ROM programs with a fixed content designed for a hypothetical didactic situation cannot be satisfactory then with these methodological prerequisites. The necessity to meet specific user requirements gets stronger and stronger. LAVAC software allows precise follow-up of each learner's activity and all sorts of fast and easy modifications are possible even in the presence of students: change of answering time for a whole group for any lesson in case of different student level, modification of the size or position of one or several images or texts thanks to multiselection tools (the set-up for one will be applied to all selected elements), addition or suppression of one or several questions, change in marking, creation of hypermedia links, etc.

This concept which few cognitive scientists are concerned about is what I call *"re-multimediatizing"*.

Conclusion

Thanks to the familiar cognitive operations implemented by this type of methodology, the learner will be able to successfully identify the new linguistic and extra-linguistic data he or she has progressively acquired, in relation with his or her pre-existing knowledge network.

The assessment of the unconscious mental organisation of the acquired data should then become conscious through final testing in order to improve it if possible, with the help of the teacher, if necessary. Language skills and knowledge acquisition will then normally occur through 'participative coupling' (Varela, 1994) and representation construction.

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